NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION SYSTEM, MICROIRRIGATION

(no.)
CODE 441

DEFINITION

An irrigation system for distribution of water directly to the plant root zone by means of surface or subsurface applicators.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes.

To efficiently and uniformly apply irrigation water and maintain soil moisture for optimum plant growth.

To apply chemicals.

CONDITIONS WHERE PRACTICE APPLIES

On sites where the soils and topography are suitable for irrigation and proposed plants and where a microirrigation system is the most desirable method of irrigation.

Microirrigation systems, including subsurface drip irrigation (SDI), shall consist of bubblers (generally< 60 gal/hr), drip or trickle emitters and tapes (generally< 2 gal/hr), or spray or spinners (generally< 45 gal/hr).

Microirrigation is suited to orchard and row crops, windbreaks, greenhouse crops, residential and commercial landscape systems, steep slopes where other methods would cause excessive erosion, and on areas where other application devices interfere with cultural operations.

CRITERIA

Laws and regulations. This practice must conform to all federal, state, and local laws and regulations. Laws and regulations of particular concern include those involving wetlands, water rights, land use, property easements, preservation of cultural resources, and endangered species.

General. The system shall be designed to uniformly apply water and/or chemicals directly to the plant root zone to maintain soil moisture within the range for good plant growth without excessive water loss, erosion, reduction in water quality, or salt accumulation.

Depth of application. Net depth of application shall be sufficient to replace water used by the plant during the plant peak use period or critical growth stage without depleting soil moisture in the root zone below the management allowed depletion (MAD). Gross depth of application shall be determined by using field application efficiencies consistent with the conservation use of water resources. Applications shall include adequate water for leaching to maintain a steady state salt balance. The net depth of application shall be expressed as inches per day per unit of design area.

$$F_n = 1.604 \frac{QNTE}{AF}$$

Where: F_n = net application depth,
inch/day/square feet of design area

Q = discharge rate, gallon/hour/emitter

N = number of orifices or emitters

T = operating hr/day, 22 hours maximum

E = field application efficiency, expressed as a decimal, design for < 0.90

A = square feet field area served by N

F = design area / field area

1.604 = units conversion constant

System capacity. The system capacity shall be adequate to meet peak use water demands for all plants to be irrigated plus reasonable water losses (evaporation, runoff, and deep percolation) during application periods.

Peak daily irrigation water requirements must be delivered by the system in 90 percent of the time available, but not exceed 22 hours of operation per day. Field application efficiency (E) for design purposes shall not exceed 90 percent.

For non-orchard crops, the design area may be less than 100 percent of the field area (A) but no less than the mature crop root zone area. For orchard crops, it is desirable to wet the entire area under the canopy of the mature tree. Refer to National Engineering Handbook (NEH), Part 623, Chapter 7, to calculate the percent of total crop area wetted (P_w) and determine desirable distribution for specific crops.

Emitter discharge rate. The design discharge rate of applicators shall be determined from manufacturer's data for the expected operating range. The discharge rate shall not create runoff within the immediate application area. For bubbler irrigation, a basin beneath the plant canopy is required for water control, with applications confined to the basin area.

Number and spacing of emitters. The number and spacing of emitters along the lateral line shall be adequate to provide water distribution to the plant root zone and percent plant wetted area (P_w). National Engineering Handbook (NEH), Section 15, Chapter 7, shall be used to determine the P_w.

Applicators must provide an overlap of wetting pattern within the root zone of all crops except trees and shrubs.

Operating pressure. Design pressure shall follow manufacturer recommendations. Operating pressure must compensate for component pressure losses and field elevation effects.

Emitter manufacturing variability. The manufacturer's coefficient of variation (C_V) shall be less than 0.07 for point source emitters and less than 0.20 for line source emitters.

Allowable pressure variations - manifold and lateral lines. Manifold and lateral line design pressure, must limit applicator discharge variation to 20 percent of the discharge rate. Pressure shall conform to manufacturer's recommendations.

Allowable pressure variations - Main and submain lines. Main and submain lines shall be designed meet design requirements of the manifold and lateral lines. Pressure shall be provided to overcome friction losses in the pipelines and appurtenances (valves, filters, etc.) Pipe sizes for mains and submains shall maintain flow velocities and emission uniformity (EU) within recommended limits (NEH Section 15, Chapter 7).

Main and submain lines shall be designed following NRCS conservation practice standard Irrigation Water Conveyance, Pipelines, (430).

Filters. A filtration system (filter element, screen, strainer, or filtration) shall be provided at the system inlet. Under clean conditions, filters shall be designed for a head loss of five pounds per square inch (PSI) or less.

The filter shall be sized to prevent passage of solids that might obstruct emitter openings. Filtration systems must remove solids equal to or larger than one-fourth the emitter opening diameter, or the emitter manufacturer's recommendations, whichever is more stringent.

The filter system shall provide sufficient filtering capacity so that backwash time does not exceed 10 percent of system operation time. Within this 10 percent time period, the pressure loss across the filter shall remain within the manufacturer's specification and not cause unacceptable EU.

Filter/strainer systems designed for continuous flushing shall not have backwash rates exceeding 1.0 percent of the system flow rate or exceeding the manufacturer's specified operational head loss across the filter.

Pressure regulators. Pressure regulators shall be used where topography and/or applicator type dictate their use.

Chemical water treatment. Proper maintenance and water treatment shall be followed to prevent clogging based upon dripper and water quality characteristics. ASAE EP405.1 contains guidelines for chemical water treatment.

System flushing. Appropriate fittings shall be installed at the ends of all mains, submains, and laterals to facilitate flushing. A minimum flow velocity of one foot/second is considered adequate for flushing.

Subsurface Irrigation. Emitter line depth shall consider the auxiliary irrigation methods used for leaching, germination, and initial development. Maximum lateral line distance from the crop row shall be 24 inches for annual row crops and 48 inches for vineyard and orchard crops. EU shall be designed for a minimum of 85 percent.

Water flow in the dripline shall be level to 2 percent downgrade with a maximum length of 660 feet. If these conditions are not met, the design shall be supported by engineering (hydraulic) documentation that show EU of 85 percent or greater.

Additional Criteria for Chemigation.

System EU shall not be less than 85 percent where fertilizer or pesticides are applied through the system.

Injectors (chemical, fertilizer, or pesticides) and other automatic operating equipment shall be located adjacent to the pump and power unit, placed in accordance with manufacturer's recommendation and include integrated back flow prevention protection.

Chemigation shall be accomplished in the minimum length of time needed to deliver the chemicals and flush the pipelines. Application amounts shall be limited to the minimum amount necessary, as recommended by the chemical label.

CONSIDERATIONS

Where natural precipitation and/or stored soil water is not sufficient for germination, special provisions should be made for germination.

Water quality is usually the most important consideration when determining whether a microirrigation system is feasible. Well and surface water often contains high concentrations of undesirable minerals (chemicals). Surface water can contain organic debris. Well water can also contain sand. The irrigation water supply should be properly tested to determine feasibility and treatment needed for microirrigation.

Pest or nutrient management planning should address the timing and rate of chemical applications.

On systems where chemicals are injected, injected nutrients may react with other chemicals in the irrigation water to cause precipitation and plugging.

Consider the potential for saline seeps or other salinity problems.

Whenever possible, laterals should be laid downslope for slopes of less than 5 percent. For steeper terrain, lateral lines should be laid along the field contour and pressure compensating emitters or pressure control devices used along downslope laterals.

P_w is not required where capillary action (upflux) will supply a portion of the consumptive use.

PLANS AND SPECIFICATIONS

Plans and specifications for microirrigation shall meet this standard and shall describe the requirements needed to achieve its purpose.

OPERATION AND MAINTENANCE (O&M)

An O&M plan must be prepared and discussed with the owner/operator. The plan shall provide specific instructions for operating and maintaining the system to ensure that it functions properly, including periodic inspections and repair or replacement of damaged components.

Frequent maintenance is essential to keep emitters functioning at design flow. Typical maintenance items include:

Clean or backflush filters when needed.

Flush lateral lines regularly.

Check applicator discharge often; replace applicators as necessary.

Check operating pressures often; a pressure drop (or rise) may indicate problems.

Check pressure gauges to ensure proper operation; repair/replace damaged gauges.

Inject chemicals as required to prevent precipitate buildup and algae growth.

Check chemical injection equipment regularly to ensure proper operation.

Check and assure proper operation of backflow protection devices.